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Rodent Exclosures for the Subalpine Zone in the Central Colorado Rockies

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Two exclosures established in the subalpine zone of the central Colorado Rockies have effectively excluded rodents from an Engelmann spruce regeneration study. The exclosures have withstood deep snowpacks and required little maintenance during 6 years. Method of construction and recommendations for use are discussed.

Keywords: Regeneration, rodents, *Picea engelmannii*.

Effective rodent control may be necessary for direct seeding in reforestation of conifers (Schubert and Adams 1971). Without some form of control, rodents may consume all the seed. Voles and pocket gophers may be particularly damaging.

Rodents in the subalpine zone in the Front Range of the central Colorado Rockies that damage conifer seed and seedlings include—deer mice (*Peromyscus maniculatus* Wagner), mountain voles (*Microtus montanus* Peale), heather voles (*Phenocomys intermedius* Merriam), red-backed voles (*Clethrionomys gapperi* Vigors), chipmunks (*Eutamias* spp.), northern pocket gophers (*Thomomys talpoides* Richardson), and snowshoe hares (lagomorphs).

A study was begun in 1967-68 on the Fraser Experimental Forest in the central Colorado Rockies to identify major climatic, physiographic, and biotic factors affecting Engelmann spruce (*Picea engelmannii* Parry) regeneration in clearcut openings. The study included artificial seeding. Because rodents and lagomorphs were a potential source of seed and seedling loss, we sought to eliminate them as a variable.

Small cone screens were not used to protect seeds and seedlings from rodents because they tend to alter microsites—temperature, moisture, and radiation. Therefore, two rodent exclosures approximately 100 x 110 ft were established—one on a 10- to 12-percent north-facing slope and the other on a 12- to 15-percent south slope (fig. 1). Both exclosures were at an eleva-

Figure 1.—A finished section of the rodent exclosure fence.

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tion of 10,600 ft. The purpose of this Note is to describe construction of the exclosures, relate their effectiveness, and point out their utility.

Construction

These exclosures, while resembling pocket gopher exclosures described by Keith (1961), have major differences. A creosote-treated wooden post, 6½ ft long and 4 to 6 inches in diameter, was set at each corner and midway between corners. Posts were set 30 inches in the ground with 40 pounds of concrete at the base of each post. The remaining portion of the post hole was filled and tamped with soil. Standard 6-ft metal fence posts were driven into the ground to an approximate depth of 2 ft at roughly 5-ft intervals in the spaces between wooden posts.

A trench, roughly 6 inches deep and 6 inches wide, was dug along the outer perimeter of the exclosure so that the inside wall of the trench was in line with the posts (fig. 2). Hardware cloth was stapled to wooden posts and wired to

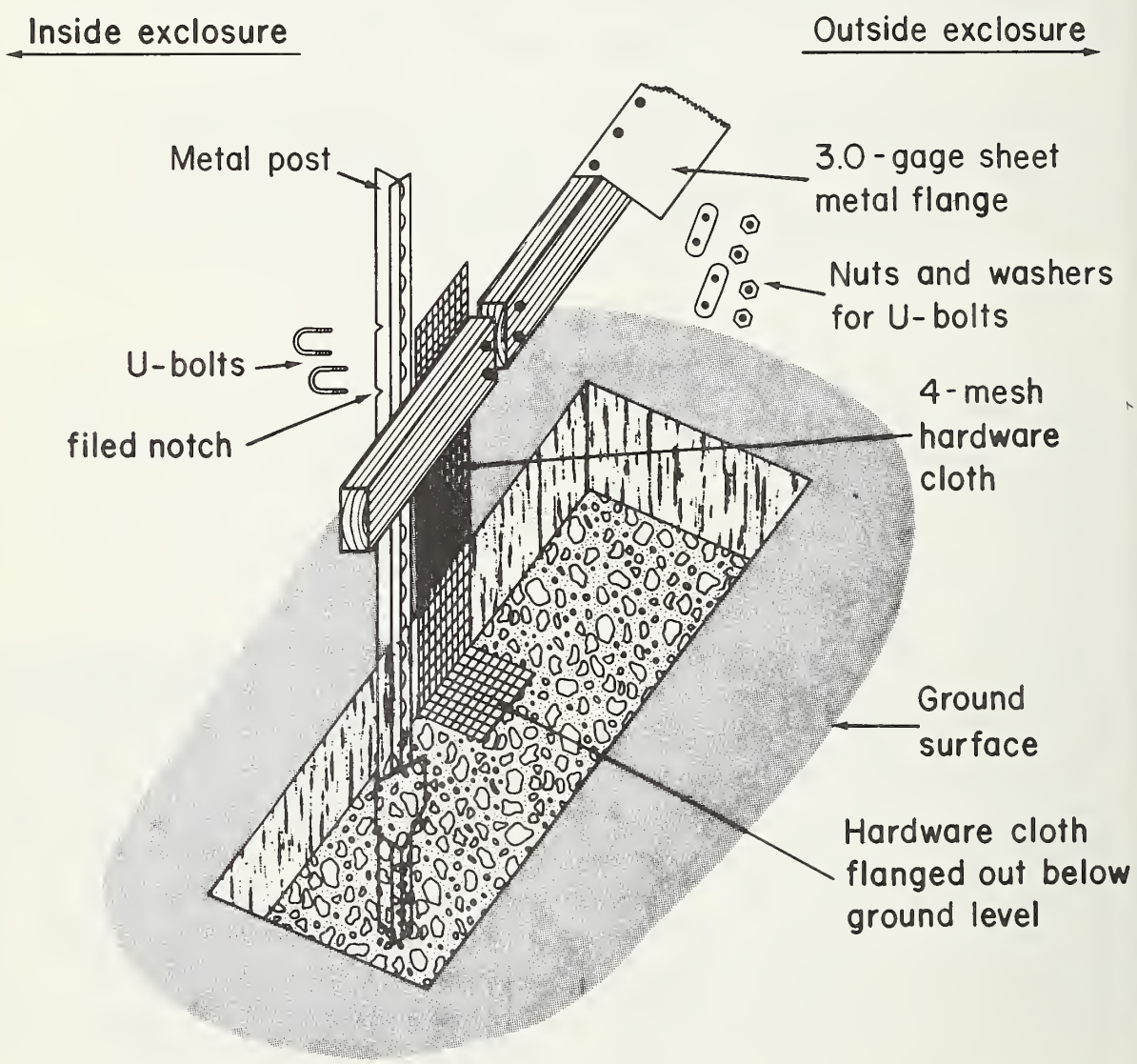

Figure 2.—A schematic diagram of the rodent exclosure fence, illustrating the construction at a rail (2- by 4-inch) joint with a metal post.

metal posts on the sides facing away from the exclosure. The hardware cloth was bent along the long axis at a point 4 inches from the edge to form a right angle which was buried 4 inches in the trench, leaving 28 inches above the ground.

Wooden rails of standard 2- by 4-inch construction lumber approximately 10 ft long were attached to the outside of the posts, 28 inches above the ground, so that the upper edge of the hardware cloth was even with the top of the rails between the posts and the rails (fig. 2). Rails treated with pentachlorophenol to prevent deterioration were nailed to wooden posts and bolted to metal posts with U-bolts ¼ inch in diameter, 2 inches wide, and 4½ inches long. Two U-bolts were used at posts where adjoining rails abutted, whereas only one U-bolt was used to attach rails to posts between joints. To insure more precise construction of the exclosures, wooden rails were cut and drilled for U-bolts on the construction site. Notches in which the U-bolts rested were filed on the inside edge of metal posts to prevent rails from collapsing. The hardware cloth was stapled to the rails at 3- to 4-inch intervals. Thirty-gage sheet-metal strips, 6 inches by 10 ft, were overlapped and nailed to the top edge of the rails with 1¼-inch roofing nails and then bent downward to an approximate 45° angle. The sheet metal was painted black to make the exclosures less conspicuous.

For the exclosures to be effective, all nearby trees and slash from which rodents could climb and jump into the exclosure should be removed. Excluding the time required for removal of such materials, an exclosure can be installed in approximately 6 to 8 weeks by a two-man crew.

Materials and Equipment

Costs and amount of materials have not been included because size of exclosures and costs are both variable.

Treated wood posts—4 to 6 inches by 6½ ft
Steel fence posts—6 ft
Wooden rails, standard construction lumber—2 inches by 4 inches by 12 ft
Hardware cloth, galvanized 4-mesh rolls—100 ft by 36 inches
Steel metal flashing, galvanized —10 ft by 6 inches
U-bolts, ¼ inch in diameter, 2 inches wide by 4½ inches long
Nails, roofing—1¼ inches
Nails, construction—12 penny
Staples—½ inch long
Baling wire—12 gage
Premix, drymix concrete—40-pound sacks
Pentachlorophenol
Special Equipment:
Portable generator
Power drill
Power hand circular saw

Results

The exclosures were successful in excluding rodents, except pocket gophers, from the study areas (Noble and Shepperd 1973). These gophers entered the exclosures either by digging under the buried hardware cloth or tunneling through the snow when the snowpack covered the exclosures. However, these animals were successfully controlled by trapping.

The exclosures have successfully withstood snow conditions for 6 years (1968 to 1974), and annual maintenance has been minimal even though snow depths reached a maximum of 106 inches in 1972.[2] The north exclosure required no maintenance, whereas 4 to 5 man days were needed in June of each year to repair damage to the south exclosure. The north slope was rocky with exposed bedrock in many places, while the south slope was covered with deeper soil containing few rocks. Because the soil was more easily penetrable on the south exclosure, the weight of snow pushed the metal posts with attached rails deeper into the ground—generally 2 to 4 inches each year. Entire sections of fence between wooden posts were often sunken, but rails did not slip down metal posts. Therefore, it was relatively simple to lift sunken fence sections to their original height by loosening U-bolts, jacking up rails, filing new notches for U-bolts, and retightening them. After 4 to 5 years, a few metal posts were pushed so far into the ground that U-bolts could no longer be secured to the posts. Such posts were replaced with wooden posts anchored in concrete, which helped stabilize the fence. Replacement of 2- by 4-inch rails has been limited to those that were defective when installed, and was accomplished without much difficulty using hand tools.

Conclusions and Recommendations

The exclosures were effective, and with minimal alterations could be improved. The problem of pocket gopher entry, for example, can be easily solved by burying the hardware cloth to a depth of 24 inches as recommended by Keith (1961), and extending hardware cloth to a

[2]*Unpublished data on file at the Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colorado.*

height above the rails that would prevent gophers entering the exclosure by tunneling over the top during winter. Also, it would be a simple matter to attach strands of barbed wire above the rails to exclude domestic livestock or deter deer and elk if they were a problem. Similarly, the problem of the fence sinking into deep soil could be reduced, if not eliminated, by placing posts in concrete at 25-ft intervals.

This type of exclosure is recommended for research studies or outplantings from seed-provenance studies when rodents might otherwise destroy the experiment, or for experiments involving concentrations of nursery stock under field conditions.

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